Hidden in plain sight, Oregon’s massive Newberry Volcano is the largest volcano in the Cascades volcanic arc and covers an area the size of Rhode Island. Unlike familiar cone-shaped Cascades volcanoes, Newberry was built into the shape of a broad shield by repeated eruptions over 400,000 years. About 75,000 years ago a major explosion and collapse event created a large volcanic depression (caldera) at its summit. Newberry last erupted about 1,300 years ago, and present-day hot springs and geologically young lava flows indicate that it could reawaken at any time. Because of its proximity to nearby communities, frequency and size of past eruptions, and geologic youthfulness, U.S. Geological Survey scientists are working to better understand volcanic activity at Newberry and closely monitor the volcano for signs of unrest.

Rising gradually southward to 4,000 feet above the City of Bend, Oregon, Newberry Volcano appears from Bend as a broad ridge on the horizon. Extending approximately 75 miles north to south and 27 miles east to west, the shield-shaped volcano and its extensive apron of lava flows cover almost 1,200 square miles, an area about the size of the State of Rhode Island, making it the largest volcano of the Cascades volcanic chain. This giant volcano is unlike a typical Cascade Range cone-shaped volcano (called a “stratocone”), such as South Sister to the west of Bend or Mount Rainier in Washington. Instead, Newberry is a “composite volcano” formed by diverse styles of eruption and has as many as 400 volcanic vents scattered across its slopes. Numerous lava flows drape its flanks, and some that were very fluid when erupted—like those typical of Hawaiian volcanoes—extend well beyond its base.

Very explosive eruptions, similar to that of Mount St. Helens in 1980, have occurred near Newberry’s summit and produced high plumes and flows of hot volcanic gases and ash (jagged tiny particles of rock and volcanic glass). A much bigger explosive eruption produced the large volcanic depression or “caldera” at the summit; its associated volcanic-ash deposits can be found as far away as the San Francisco Bay Area in California.

Volcanic activity at Newberry has created a unique and spectacular landscape, and in 1990 the Newberry National Volcanic Monument was established within Deschutes National Forest. Operated by the U.S. Forest Service, the monument encompasses all of the Newberry caldera, parts of the upper slopes of the volcano, and most of the volcano’s “Northwest Rift Zone.” Newberry caldera holds two beautiful lakes, Paulina Lake and East Lake, popular for fishing, boating, swimming, and camping.

**How Did Newberry Grow to be the Largest Volcano in the Cascades?**

Newberry Volcano lies east of the Cascades volcanic crest at the west margin of a broad volcanic region known as the High Lava Plains. The high-standing part of Newberry covers...
about 40 miles north-south by 25 miles east-west and encompasses nearly all of the volcano’s vents. However, Newberry’s lava flows extend much farther than this high part and to the north include the area of what is now downtown Bend, as well as the Redmond Municipal Airport. About 350,000 years ago, an early lava flow erupted from Newberry and flowed north until it reached Smith Rock, where it filled and moved down the channel of the Crooked River and also shifted the channel of the Deschutes River.

Before formation of the caldera, Newberry’s summit was 500 to as much as 1,000 feet higher than present-day 7,984-foot Paulina Peak. Shortly after the most recent caldera-forming eruption, vents on the north side of Newberry fed large lava flows westward, which created and then flowed through Lava River Cave, diverting the Deschutes River. The lava flow that underlies downtown Bend and the Redmond airport is from that same eruption. Once the caldera was formed, more eruptions began to fill it with lava flows, and lava also erupted at numerous sites outside the caldera, covering much of the volcano’s north and south flanks. Between the end of the last Ice Age (about 12,000 years ago) and 7,700 years ago, Newberry Volcano erupted at least a dozen times.

**Eruption that Formed Crater Lake Covers Newberry with Ash**

About 7,700 years ago, a massive eruption caused the collapse of ancient “Mount Mazama,” forming a caldera that holds present-day Crater Lake, Oregon. Winds blew volcanic ash from that eruption northeast over Newberry Volcano, which is 75 miles away, covering much of it in a blanket of dusty ash and pumice as much as 6 feet thick on the volcano’s south flank. In Newberry caldera, the foundation of a Native American house was discovered underneath this ash layer, known as the Mazama ash, suggesting that the eruption disrupted an ancient human occupation. The ash sharply separates lava flows of Newberry’s older eruptions from lava flows produced by the volcano’s younger eruptions.

### Newberry Volcano Quick Facts

| **Volcano type:** shield-shaped composite | **Area:** 1,200 square miles—about the size of the island of Rhode Island |
| **Nearby Towns:** Bend, Sunriver, LaPine, and Redmond |
| **Population near Newberry lavas:** about 200,000 |
| **Caldera area:** 17 square miles |
| **Elevation:** 7,984 feet above sea level—Paulina Peak summit |
| **Height above Bend:** About 4,000 feet |
| **Last eruption:** about 1,300 years ago—Big Obsidian Flow |
| **Oldest lavas:** about 400,000 years |
| **Number of volcanic cones and vents:** more than 400 |
| **Estimated total volume:** 120 cubic miles (mi³) (for example, South Sister is 5 mi³ and Mount St. Helens is 6 mi³) |
| **Volume of Lava Butte cone and flow:** Less than 1 cubic mile |
This map highlights the Newberry National Volcanic Monument and the youngest lava flows on Newberry Volcano which all erupted since about 7,700 years ago. Stars show volcanic vents that produced these young cones and lava flows. The Northwest Rift Zone extends from the caldera to Lava Butte. This fissure system erupted about 7,000 years ago and produced many lava flows and cones over a distance of about 20 miles. Lava Lands Visitor Center is located at the base of Lava Butte; a road leading to this cinder cone’s summit is open seasonally. Big Obsidian Flow, located within Newberry Caldera, erupted about 1,300 years ago and is the youngest of all the lavas on Newberry Volcano. A trail up onto the obsidian flow is a popular visitor destination, as is the trail at Lava Cast Forest, where lava molds of trees can be seen. Another popular destination is Lava River Cave, an underground lava tube nearly a mile long in an older lava flow.
This map shows the region surrounding Newberry Volcano, Oregon, which first began to erupt about 400,000 years ago. Extending about 75 miles north to south and 27 miles east to west, the volcano and its broad apron of lavas (outlined in yellow) cover a total area of almost 1,200 square miles, making it the largest volcano of the Cascades volcanic chain. Colors show the extent of lavas erupted before the caldera formed about 75,000 years ago; after caldera formation; after glaciation but before the catastrophic eruption about 7,700 years ago that destroyed ancient “Mount Mazama” and formed Crater Lake, an event that deposited a thick volcanic ash layer over Newberry Volcano; and after deposition of Mazama ash. The Deschutes River, which lies on the volcano’s western flank, has at times been shifted to the west by Newberry lavas. At other times, eruptions from volcanoes on the Cascades crest to the west have shifted the river channel eastward.
Hazards from Newberry Volcano

U.S. Geological Survey monitoring of Newberry Volcano will in most instances be able to provide warnings weeks to months before most impending hazardous volcanic activity. These warnings along with community emergency-response plans should provide sufficient time for orderly evacuations of people and property. Volcano hazards at Newberry include:

Lava flows—Fluid lavas may flow downslope from vents on Newberry's flanks. The most severe hazards scenario for this type of eruption would be for lava to enter populated areas, burning and burying structures, and blocking Highway 97 or other roads. Lava flows could also ignite forest fires and temporarily block the Deschutes River, causing flooding upstream from rising waters and downstream flooding after the blockages are overtopped or bypassed.

Ash, pumice, and cinders (collectively named tephra)—Consisting of pumice, rock fragments, and small particles of volcanic glass, tephra is produced by eruptions such as the one that created the cinder cone of Lava Butte, and the early explosive phase of the eruption that generated the Big Obsidian Flow about 1,300 years ago and deposited windblown ash as far away as Idaho. Cinder cone eruptions on the volcano’s flank would produce relatively small volumes of tephra that would mostly accumulate close to the erupting vent, but pumice and ash eruptions from Newberry caldera could send larger amounts of ash to high altitudes, where it could be blown by wind to populated regions and also become a hazard to aviation. Hot cinders and ashfall would likely ignite forest fires, and large volumes of gas would be released. Breathing ash particles and volcanic gases can irritate eyes and lungs and cause health issues.

Pyroclastic flows—Eruptions of hot ash, pumice, and gases formed a pyroclastic flow deposit about 75,000 years ago as part of the eruption that created Newberry caldera. These infrequent but extraordinarily hot and fast moving flows would move quickly down the slopes of Newberry and be very destructive.

Earthquakes and faulting—in the event of an eruption, swarms of small earthquakes will accompany magma (molten rock) movement beneath the surface of Newberry Volcano. Although most such volcanic earthquakes are too small to cause damage away from the volcano, ground breakage could generate “fault scarps,” which are linear fractures that could cut the surface of Newberry Volcano.
Why Monitor Newberry Volcano?

The U.S. Geological Survey (USGS) considers Newberry Volcano to be a very high threat volcano because of its recent volcanic activity (within the past 1,500 years) in an area where numerous people live. Monitoring can help scientists detect signs that the volcano is reawakening so that they can warn nearby communities of impending hazardous activity. USGS monitoring stations at Newberry, like the one shown here, contain instruments to detect the early and subtle signs of a reawakening volcano, including both a Global Positioning System (GPS) receiver, which measures swelling or deflation of the ground, and seismic instruments, which detect distinctive volcanic earthquakes caused by molten rock (magma) movement beneath a volcano. Data from the USGS monitoring network at Newberry Volcano is available at http://volcanoes.usgs.gov. (USGS photo by Liz Westby.)

When a volcano is well monitored, we gain the precious commodity of time—time to work with and educate those at risk, time to develop evacuation plans, and time to mitigate hazards to critical infrastructure.

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